What is Claimed Is:

1. An apparatus for use with a coherent source of radiation in order to measure a strain induced into a substrate, the apparatus comprising:

a passive fiber optic ring;

at least one sensor having a predetermined shape and in line with the fiber optic ring, the at least one sensor coupled to the substrate;

coupling means for i) introducing a portion of radiation emitted by the coherent source into the passive fiber optic ring and ii) receiving a portion of the radiation resonant in the passive fiber optic ring;

a detector for detecting a level of the radiation received by the coupling means and generating a signal responsive thereto; and

a processor coupled to the detector for determining a level of the strain inducing into the substrate based on a rate of decay of the radiation in the passive fiber optic ring.

2. The apparatus according to claim 1, wherein the predetermined shape is a slack area formed between ends of the sensor where it is coupled to the substrate.

3. The apparatus according to claim 2, wherein the signal generated by the detector is based on a change in the predetermined shape of the sensor as the strain is induced into the substrate.

4. The apparatus according to claim 2, wherein the predetermined shape is disposed between ends of the sensor.

5. The apparatus according to claim 1, wherein a first one of the at least one sensor is oriented along a first axis of the substrate.

6. The apparatus according to claim 1, wherein a second one of the at least one sensor is oriented along a second axis of the substrate.

7. The apparatus according to claim 1, wherein the at least one sensor includes a fiber bragg grating (FBG).

8. The apparatus according to claim 1, wherein the coupling means is a single optical coupler.

9. The apparatus according to claim 1, further comprising a filter placed in an optical path between the coupling means and the detector to selectively pass the received portion of radiation from the passive fiber optic ring to the detector.

10. The apparatus according to claim 9, wherein the filter passes radiation to the detector based on a wavelength of the radiation.

11. The apparatus according to claim 1, wherein the coupling means includes i) a first coupler for introducing the portion of the radiation emitted by the coherent source to a first section of the optical fiber and ii) a second coupler for receiving the portion of the radiation in the optical fiber at a second section thereof.

12. The apparatus according to claim 1, wherein the predetermined shape is a tapered portion formed between ends of the sensor, the predetermined shape exposed to a surrounding ambient.

13. The apparatus according to claim 12, wherein an evanescent field of the radiation traveling within the fiber is exposed to the surrounding ambient.

14. The apparatus according to claim 12, wherein the tapered portion is formed by heating and adiabatic stretching of the optical fiber.

15. The apparatus according to claim 1, wherein the coherent source of radiation is an optical parametric generator.

16. The apparatus according to claim 1, wherein coherent source of radiation is an optical parametric amplifier.

17. The apparatus according to claim 1, wherein coherent source of radiation is a laser.

18. The apparatus according to claim 1, wherein the coherent source of radiation is a pulsed laser.

19. The apparatus according to claim 1, wherein the coherent source of radiation is a continuous wave laser.

20. The apparatus according to claims 17, 18 or 19, wherein the laser is an optical fiber laser.

21. The apparatus according to claim 19, wherein the continuous wave laser is a tunable diode laser having a narrow band.

22. The apparatus according to claim 21, further comprising an isolator coupled between the laser and the coupling means and in line with the radiation emitted from the laser, the isolator minimizing noise in the laser.

23. The apparatus according to claim 1, wherein the dissipation of the radiation from the fiber as the strain is induced in the substrate changes a rate of decay of the radiation received by the coupling means.

24. The apparatus according to claim 1, wherein the passive optical fiber is formed from one of fused silica, sapphire and fluoride based glass.

25. The apparatus according to claim 1, wherein the passive optical fiber is formed from a hollow fiber.

26. The apparatus according to claim 24 or 25, wherein the passive optical fiber is a single mode fiber.

27. The apparatus according to claim 24 or 25, wherein the passive optical fiber is a multi-mode fiber.

28. The apparatus according to claim 1, wherein the coherent source is a single mode laser tunable in the wavelength region of about 1250 nm and about 1650 nm.

29. The apparatus according to claim 1, wherein the coherent source has a wavelength region of about 1300 nm.

30. The apparatus according to claim 1, wherein the coherent source has a wavelength region of about 1550 nm.

31. The apparatus according to claim 1, wherein the passive optical fiber resonates at a wavelength between a visible to a mid-infrared region of an electro-magnetic spectrum.

32. The apparatus according to claim 1, further comprising an input detector for determining when energy from the laser is provided to the optical fiber.

33. The apparatus according to claim 32, further comprising control means to deactivate the laser based on the receiving means receiving radiation from the optical fiber after the input detector determines that the laser provided energy to the optical fiber.

34. The apparatus according to claim 33, wherein the control means and the input detector are coupled to the processing means.

35. The apparatus according to claim 1, wherein the portion of the radiation coupled into the optical fiber is less than about 1% of the radiation provided to the coupling means.

36. The apparatus according to claim 1, wherein the portion of the radiation coupled into the optical fiber is variable.

37. The apparatus according to claim 1, wherein the portion of the radiation coupled into the optical fiber is varied based on a loss within the passive fiber optic loop.

38. The apparatus according to claim 37, wherein the loss within the optical fiber is based on at least connector losses and fiber losses.

39. The apparatus according to claim 1, wherein the optical fiber is at least about 1 meter long.

40. The apparatus according to claim 1, wherein the optical fiber is at least about 10 meters long.

41. The apparatus according to claim 1, wherein the optical fiber is at least about 1 Km long.

42. An apparatus for measurement of strain comprising:

a passive resonant fiber optic ring;

at least one sensor in line with the fiber optic ring, each of the at least one sensor having a tapered portion;

a coherent source emitting radiation;

a first optical coupler to provide at least a portion of the radiation emitted by the coherent source to a first section of the passive resonant fiber ring;

a second optical coupler for receiving a portion of the radiation in the passive resonant fiber ring from a second section of the resonant fiber ring; and

a processor coupled to the second optical coupler for determining a level of the strain based on a rate of decay of the radiation received by the second optical coupler.

43. The apparatus according to claim 42, further comprising a first optical detector coupled between the second optical coupler and the processor for generating a signal responsive to the radiation received by the second optical coupler.

44. The apparatus according to claim 42, further comprising a second optical detector coupled between the first optical coupler and the processor for determining when energy from the laser is provided to the passive fiber optic ring.

45. The apparatus according to claim 44, wherein the second optical detector generates a trigger signal to the processor responsive to receiving radiation from the coherent source.

46. The apparatus according to claim 42, wherein the first and second optical couplers are a unitary coupler.

47. The apparatus according to claim 42, wherein each of the at least one sensor comprises a preformed portion disposed between ends of the sensor.

48. A method for measuring a strain in a material, the method comprising:

forming a sensor from an optical fiber by tapering a portion the optical fiber;

coupling the sensor to the material such that a portion between the ends of the sensor has a predetermined amount of slack;

exposing the material to a strain;

emitting radiation from a coherent source;

coupling at least a portion of the radiation emitted from the coherent source into the fiber optic ring;

receiving a portion of the radiation traveling in the fiber optic ring; and

determining a level of strain based on a first rate of decay of the radiation within the fiber optic ring.

49. A method according to claim 48, further comprising the step of exposing an evanescent field of the radiation traveling within the fiber to an ambient surrounding the material.

50. A method according to claim 49, further comprising the steps of:

determining a baseline rate of decay in the fiber indicative of a relaxed state of the material; and

comparing the baseline rate of decay with the first rate of decay.